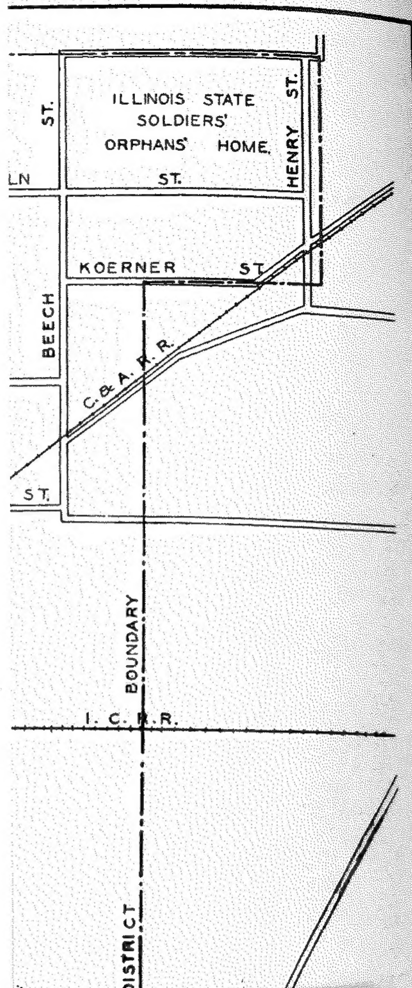
Bloomington and Normal Sanitary District

1919 - 1936



ILLINOIS STATE SOLDIERS' ORPHANS' HOME.
ST.
HENRY ST.
LN
ST.
KOERNER ST.
BEECH
C. & A. R. R.
ST.
BOUNDARY
I. C. R. R.
DISTRICT

Bloomington and Normal Sanitary District

VISITORS WELCOME

INSPECTION INVITED

Sanitation Is a Measure of Civilization

Personnel

BOARD OF TRUSTEES

FRANK DONOVAN, *President*

A. M. AUGUSTINE, *Vice President and Treasurer*

EARL R. DEPEW, *Clerk*

W. C. RADLIFF, *Attorney*

ARTHUR L. WILLIAMS, *Certified Accountant*

HARRY E. WILSON, *Superintendent*

R. KINGSLEY CORRINGTON, *Chemist and Bacteriologist*

O. G. HENDRYX, *Assistant Superintendent*

LOCATION

City Office, 304 Unity Bldg.—203 N. Main St., Bloomington
Treatment Plant, West Oakland Street Road

Introductory

The purpose of this booklet* is six-fold:

1. To furnish a convenient means by which the public of the Bloomington and Normal Sanitary district may be informed about one of its public institutions.

2. To furnish the facts as to the importance of the service which this institution performs for the welfare and health of the community.

3. To set forth in simple and understandable language the process by which this service is performed.

4. To furnish the historical background from which the necessity for this district and its functions became imperative.

5. To remove any prejudice which may exist in the public mind as to the supposed offensiveness of the process by which the treatment plant carries on its health-preserving services.

6. To lead the public henceforth to take greater interest in the operation of the treatment plant which is established and maintained by the taxpayers' money.

*Compiled and written by J. L. Hasbrouck.

HOMER W. HALL

Abbreviated Foreword

The people of Bloomington and Normal own the Sanitary District. It is and has been efficiently operated for their benefit. It is a distinct asset to this community.

By scientific operation and bacterial action the sewage waste of the two cities is so neutralized as to change this material into inoffensive elements and the liquids pour into Sugar Creek as pure water.

This interesting plant belonging to the people is becoming an attractive park, which can be, and should be, visited by our citizens so that they may inspect their property and realize just what it is.

To this end this booklet is dedicated by the Trustees whose duty it is to carry on the work.

Respectfully,

HOMER W. HALL,
County Judge.

How It Came To Be

Creation of the Bloomington and Normal Sanitary District and the resulting establishment of the district sanitary treatment plant, was a matter, not of choice, but of necessity for the community.

It had its inception in the court order accompanied by broad threats of dire consequences for public officials who should defy its implications.

This court order was to the effect that the two communities of Bloomington and Normal must cease and desist from the practice which had prevailed of pouring their untreated and raw sewage and wastes into the stream of Sugar Creek, thereby creating constant jeopardy for the health of the two cities through which the creek flowed; also creating a constant and growing nuisance for land owners whose properties adjoined the stream west and south of the cities.

In 1914, John J. Dugan, a Bloomington citizen, had filed a complaint with the Illinois Rivers and Lakes Commission against the pollution of Sugar Creek, as above mentioned, by its continued use as an open ditch to carry the sewage of Bloomington and Normal. The State Department of Health investigated and substantiated the grounds for complaint. Orders were thereupon issued that the two cities cease such pollution of Sugar Creek by September 1916. The time was later extended to April 1917.

In the interim the two communities obtained enactment of legislation to permit formation of the Sanitary District, but in May 1919 State officials reported that discharge of raw sewage into Sugar Creek was still going on. Thereupon, W. L. Sackett, superintendent of waterways division in the Department of Public Works, addressed a letter to the city officials of Bloomington and Normal, telling them in effect that unless means were at once taken to abate the nuisance caused by the pollution of Sugar Creek, the criminal code would be invoked to compel obedience to the former orders of the courts. At the same time, residents west and south of the city joined in action to bring suit for civil damages against the cities for the conditions mentioned.

In September, 1919, two suits were filed, one in behalf of Alex Bryant and the other in behalf of Henry Aicher, Lucy L. Aicher and Edward B. Detrick, directed against the City of Bloomington, the Town of Normal and several industrial concerns along Sugar Creek. Circuit Judge Edward Barry referred these suits to A. W. Peasley as special master to take evidence.

These threats from several quarters brought action at last.

Mayor F. S. Folk, of Normal, instructed attorney Richard F. Dunn, city attorney for Normal, to confer with the Mayor, E. E. Jones, of Bloomington relative to seeking a solution of the problem. Following the conference and with the consent of the two Mayors, attorney Richard F. Dunn proceeded to take the necessary steps to perfect the organization of a sanitary district.

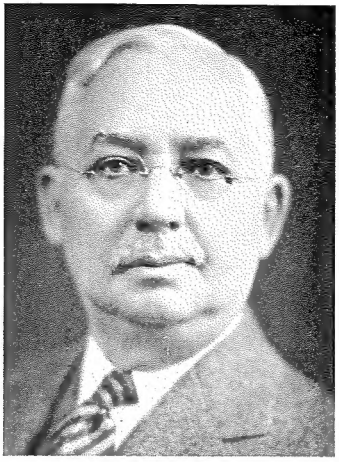
Petitions were circulated and plans made for an election on the question of the formation of a sanitary district including the two municipalities. This election, held on November 4, 1919, resulted in a majority of votes in each community favoring formation of the district; the total vote being 2,368 "yes" and 404 "no."

Court orders by County Judge James C. Riley affirmed the formation of the district and appointing the first board of trustees, viz., John W. Harber, John J. Condon, and Frederic De Loss Barber.

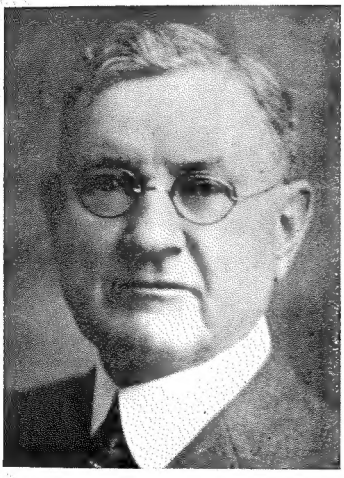
The trustees by lot drew their terms of service, Mr. Condon drawing the one year term, Mr. Harber the two year term, and Mr. Barber the three year term.

The trustees at once began a study of conditions, visited other communities where such districts existed, and studied methods of procedure to carry out the purpose of the district. Richard F. Dunn was appointed attorney to look after the legal work, and the engineering firm of Folsom and Taylor was named to make necessary plans for the sewage lines and treatment systems.

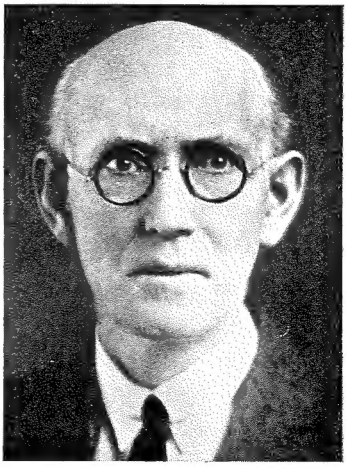
The need for large sums to consummate the work was at once apparent. The trustees submitted to the voters a proposal for an $800,000 bond issue. This proposal was voted down on November 2, 1920, and a similar proposition for a $400,000 bond issue was defeated on December 20, 1921.



JOHN W. HARBER
President
1919 — 1932

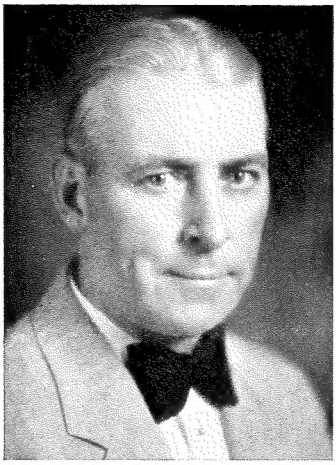


JOHN J. CONDON
Vice-President and Treasurer
1919 — 1932



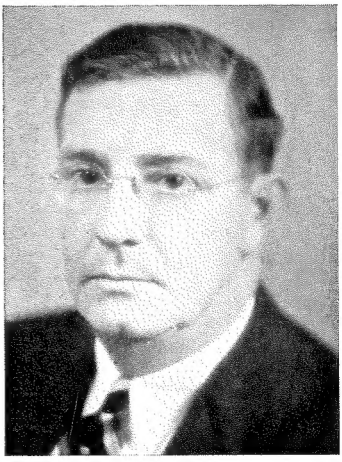
PROF. FREDERIC DELOSS BARBER
Clerk
1919 — 1924

THE FIRST BOARD OF TRUSTEES
Appointed 1919
Organizers and builders of the
BLOOMINGTON AND NORMAL SANITARY DISTRICT



FRANK J. DONOVAN
President
1936

A. M. AUGUSTINE
Vice-President and Treasurer
1935



EARL R. DEPEW
Clerk
1935

PRESENT BOARD OF TRUSTEES

During the next few years work was done for the Sugar Creek improvement and on smaller projects with money allotted to the district through the annual tax levy.

In June 1925 the special master, to whom had been referred the suits by citizens complaining of the nuisance created by the sewage carried in Sugar Creek, filed his report. In accordance with that report, Judge Barry on July 11, 1925, entered a decree declaring that the cities were maintaining a nuisance by discharging of sewage into Sugar Creek, and ordering steps to be taken within thirty days to abate the nuisance, making such abatement complete within twelve months.

This order supplied the stimulus for a third vote and by a campaign of education carried on through the press and speaking before various organizations a bond issue voted on October 27, 1925, for $700,000 was approved by a vote of 1819 for and 256 against.

The engineers employed by the district had been busy preparing plans for intercepting sewers and the construction of a treatment plant, so that as soon as the bonds were approved and sold, work could proceed. A moderate tax levy had been collected from the first year after the formation of the district. With funds thus realized preliminary work had been possible, such as open ditch work in some parts of Sugar Creek valley.

On May 6, 1926, the Board received bids for the construction of the sewage treatment plant and appurtenances, and awarded the contract on May 16, to the J. L. Simmons Company.

Construction of the plant consumed the greater part of two years. It was completed and virtually ready for operation in April, 1928, and was formally dedicated on June 7 that year in the presence of large numbers of local citizens and visiting members of the Illinois Association of Sanitary Districts, which held its fifth annual convention in Bloomington at that time.

PHYSICAL FEATURES OF THE DISTRICT

When organized, the Bloomington and Normal Sanitary District included all the territory within the limits of the City of Bloomington

and the Town of Normal except a small section in the southwest part of Bloomington, served by the Miller Park sewer system. Country Club Place addition has since been added.

The area of the district is about 8.5 square miles, all within the watershed of Sugar Creek and its tributaries. The watershed proper covers about 30 square miles.

The population of the district is practically the same as the combined population of the two cities. According to the census the combined population was 15,706 in 1870, 27,081 in 1900, 33,868 in 1920, and 37,698 in 1930.

The Illinois State Normal University brings to the community about 1,800 students from outside the city and the Illinois Wesleyan University brings about 500 students as residents during the school year. Thus the population of the two cities is about 2,300 larger than the resident population during the school period.

The water supply of Bloomington is received from Lake Bloomington, fifteen miles northeast of the city, filtered and softened at the lake and pumped to the distribution system at Division street. Bloomington has 70 miles of water mains and 8,000 service connections. The daily pumpage is about 2,555,000 gallons.

The Normal water supply is from deep wells, pumped into a reservoir and thence into the distribution system. There are 15 miles of mains; the daily pumpage is about 400,000 gallons, and there are 1,500 service connections.

PROGRESS OF THE ENTERPRISE

The transformation of the sewage system of Bloomington-Normal from the crude, unhealthful and unsanitary plan of draining off the wastes of the community through the open beds of small streams, into a co-ordinated system of drainage and sanitary treatment of the waste was accomplished through two really separate projects.

The first consisted of deepening the bed of Sugar Creek as it flowed through the two cities, so as to carry off all ordinary storm waters without overflow, and to unite into one connected system the several independent sewage outflows from the two cities.

The second project was to construct and operate a modern and scientific sewage treatment plant for converting the raw sewage from the two cities into an inoffensive, harmless and virtually uncontaminated flow which might be carried away in the ordinary stream of Sugar Creek without offense or menace to health of the people in the community.

The improving of the creek and the merging of the drainage systems was undertaken by the district trustees, while educating the public for the necessity of a bond issue to finance the larger enterprise of construction of the disposal plant.

Dredging and deepening of Sugar Creek within the boundaries of the district was undertaken as a sanitary measure. Every year previously in the season of heavy rains, the creek had overflowed its banks and spread out several hundred feet on each side of the stream. This lead to a serious annoyance and menace to the health of the residents in the area. The flood waters would enter the sewers through manholes and inlets, surcharge the sewers and back sewage into basements of homes for several blocks on each side, constituting a serious sanitary menace. A contract for dredging and deepening the bed of Sugar Creek its full length within the sanitary district was let in August, 1922, and the work was completed by January 1, 1923.

Both Bloomington and Normal have a system of combined sewers, that is, storm water and sewage are carried in the same sewers.

Bloomington has over 55 miles of sewers, ranging in size from 6 inches to 96 inches in diameter. Normal has 24 miles of sewers from 8 inches to 60 inches in diameter. A little over one third of the mileage is 12 inch.

There were formerly nine sewer outlets into Sugar Creek and its branches. Of the four largest, the valley sewer was 60 inches; the Graham Street sewer was also 60 inches; West Slough 96 inches and Orchard Lane 48 inches. All these are brick sewers. The other five are vitrified pipe sewers.

To combine and unite these into one outlet which would carry the entire sewage flow of the two cities into a central treatment plant, it was necessary to construct what is called the intercepting sewer. This starts at the outlet of Valley and Division Street sewers and cuts

Cottage Avenue and Olive Street sewers above their respective outlets. The Graham Street sewer was extended 480 feet, while the West Slough and Orchard Lane sewers were extended 1,400 feet to connect with the interceptor. West Wood Street sewer was also extended to connect with the intercepting line.

At the respective junctions of each of these trunk line sewers with the interceptor, an overflow chamber and manhole was built, which diverts the dry weather flow and a portion of the storm water into the intercepting sewer.

The intercepting sewer is two miles long, 27 inches in diameter from the Valley sewer to Graham Street outlet; 36 inches from Graham Street to West Slough and Orchard Lane; 51 inches in diameter from the latter outlet to the treatment plant. The smaller end is of vitrified pipe, the remainder of vitrified clay, single ring, segment block construction.

The interceptor has a capacity for future growth in population of the two cities, for it can handle 300 to 400 gallons per day per capita for an estimated population many years in the future. It is designed for a longer future period than is the treatment plant, for the plant can be more easily enlarged if necessary.

Contracts for the interceptor sewer and trunk connections were made in August, 1925, and the work completed in the spring of 1926.

Most of the pipe sewers in Bloomington were laid with open joints and consequently the quantity of ground water which enters the sewers is very large. The brick sewers are very old and also permit entrance of much ground water. This ground water becomes part of the sewage and must be pumped and treated at the plant. This materially adds to the cost of operation.

Measurements taken several years ago indicate that the dry weather flow of sewage was about 80 gallons daily per capita. This corresponded fairly closely with the water pumpage records. Because of ground water infiltration the quantity of sewage reaching the plant is generally considerably in excess of this amount. Pumpage records at the plant show average daily totals varying from 3,800,000 to 6,700,000 gallons. These represent from 100 gallons per capita to nearly twice that amount.

MARK R. ETHELL
Treasurer
1932 — 1935

JOHN M. WATERSON
President
1932 — 1936

WILLIAM W. MCKNIGHT
Clerk
1924 — 1932

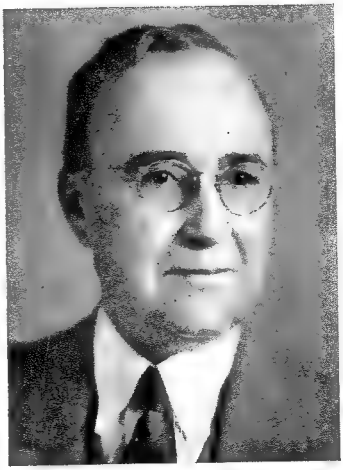
GLENN HUFFINGTON
Clerk
1932 — 1935

FORMER TRUSTEES

HARRY E. WILSON
Superintendent since Organization

R. KINGSLEY CORRINGTON
Chemist
1936

JESSE J. WOLTMAN
Supervising Engineer
since Organization



PROF. HOWARD W. ADAMS
Chemist
1919 — 1936

THE TREATMENT PLANT

Sometimes the institution by which Bloomington and Normal reduce their community wastes to a condition of impotence so far as endangering the health is concerned, is called the **Sewage Disposal Plant.** This is a misnomer, it should instead be termed the **Sanitary Treatment Plant,** and that term is universally used by sanitary engineers to designate this kind of plant.

Sewage was formerly "disposed of" by merely draining it into the channel of Sugar Creek, where the natural flow of the stream was supposed to dilute it to such an extent as to make it harmless in relation to the senses or health of the residents along the course of the stream. But Sugar Creek ordinarily goes dry in the summer time except for the flow of the sewage, fed by the normal discharge of water from the domestic and industrial units of the community.

The consumption of water in the two cities averages about 100 gallons per day for each person. Of course this amount of water is not used for drinking, bathing or other domestic purposes. Much the greater portion of the water simply goes through the pipes of industrial or domestic places and runs away through the sewage system.

Dilution of domestic or industrial waste by this normal flow of water is not sufficient. Complete treatment by modern mechanical processes therefore becomes necessary now, and in anticipation of future increase of population. Tank treatment might have sufficed for part of the year; but since all sewage had to be pumped, no economy of operation was effected by by-passing part of the raw sewage without treatment.

The plant to accomplish this was planned in 1925-26. The trustees of the sanitary district purchased a tract of land comprising 50 acres about two and a half miles southwest of the business portion of Bloomington and a half mile from the nearest built up section of the city.

A small creek draining into Sugar Creek passed through the eastern portion of the tract. It was necessary therefore to locate most of the plant on the west side of the creek, the bottom of which is about the same level as the invert of the intercepting sewer. The

course of the little creek was changed by constructing a concrete open top channel further west. The grit chamber and pumping house were located on the east side of this new channel. The crossing of the creek was made by means of a cast iron pumping main passing above the normal flow of the creek. The new channel was left with open top through the plant site except for 200 feet adjoining the pumping station, where a concrete slab top is covered with sufficient earth so that the 30 inch main from the pumping house to the settling basin is entirely concealed.

The plant was designed to take care of not only present sewage treatment requirements, but all units were constructed for taking care of 5.4 million gallons of flow per day, which would meet requirements of 55,000 population. It is estimated that this population will not be reached for 20 years. All units of the plant can be enlarged, without changing the size or location of the grit chamber or pump house, but with the addition of only one pump.

STEPS IN THE PROCESS

The process by which the raw sewage is transformed from its original condition to that of harmless and inoffensive substances, which flow downstream, or are prepared for useful commercial purposes, are roughly divided into seven stages.

First—The Grit Chamber into which the whole or raw sewage is discharged from the big interceptor sewer which carries the combined flow of all the trunk line sewers of Bloomington and Normal, by gravity flow.

Second—The pumping station, which lifts the flow from the level of the grit chamber to the higher levels of the primary settling tank and its companion purifying units.

Third—The primary settling tanks, wherein the larger portion of the solids are removed from the sewage, by settling out during the slow flow through these tanks.

Fourth—The dosing tanks, by which the effluent from the primary settling tanks is collected by mechanical devices into large volume, which when automatically and periodically released, gives it suffi-

Top—Administration Building and Pump House in winter
Bottom—Sprinkling filters in action

cient head to operate the aerating sprayer system above the filter beds.

Fifth—Filter beds, great bodies of crushed stone over which and through which the liquid is sprayed for aeration and "digestion" to further accelerate its purification.

Sixth—The secondary tank, which removes residual solids, a small percentage of solids that escape from the filter beds, returning it back again to the primary settling tanks for final removal of all solids held in solution.

Seventh—Discharge of the effluent in its cleansed and purified condition into the bed of Sugar Creek, and the drying of the digested solids or sludge which has been removed, into commercial fertilizer or other uses.

THE GRIT CHAMBER

The grit chamber, the first unit of the treatment works to receive the raw sewage, consists of three parallel rectangular concrete channels, with flat V shaped inverts, so constructed that the fluid passes through the channels at about one foot per second. Large iron gratings or screens across the flow of the current in these chambers serve to catch all the large objects such as sticks, rags, cans, bottles or other foreign substances of that nature. The screens are placed at an angle of 37 degrees with the horizontal, so that they form a natural net against the passage of the articles mentioned. The screens are cleaned out several times each day, whenever necessary and the debris taken from them is hauled away and buried.

The second section of the grit chamber slows up the flow even more than the first, so that any sand, gravel, cinders or like substance carried in the liquid will be deposited. These are mostly washings from the street pavements or gutters on unpaved streets. From the first of January to the first of May, 1936, 174 tons of this sort of deposits was removed. This material is saved and used as a foundation for the sludge drying beds, thus making a considerable saving.

When the sewage has passed through both units of the grit chamber it moves on by gravity to the "wet well" or sump of the pumping house. It is now in a liquid state except for the fine solids held in suspension.

THE PUMPING STATION

Outstanding among the several buildings comprising the treatment plant is the pumping station. Architecturally it is the gem of the group, its utilitarian features being enhanced by appropriate landscaping.

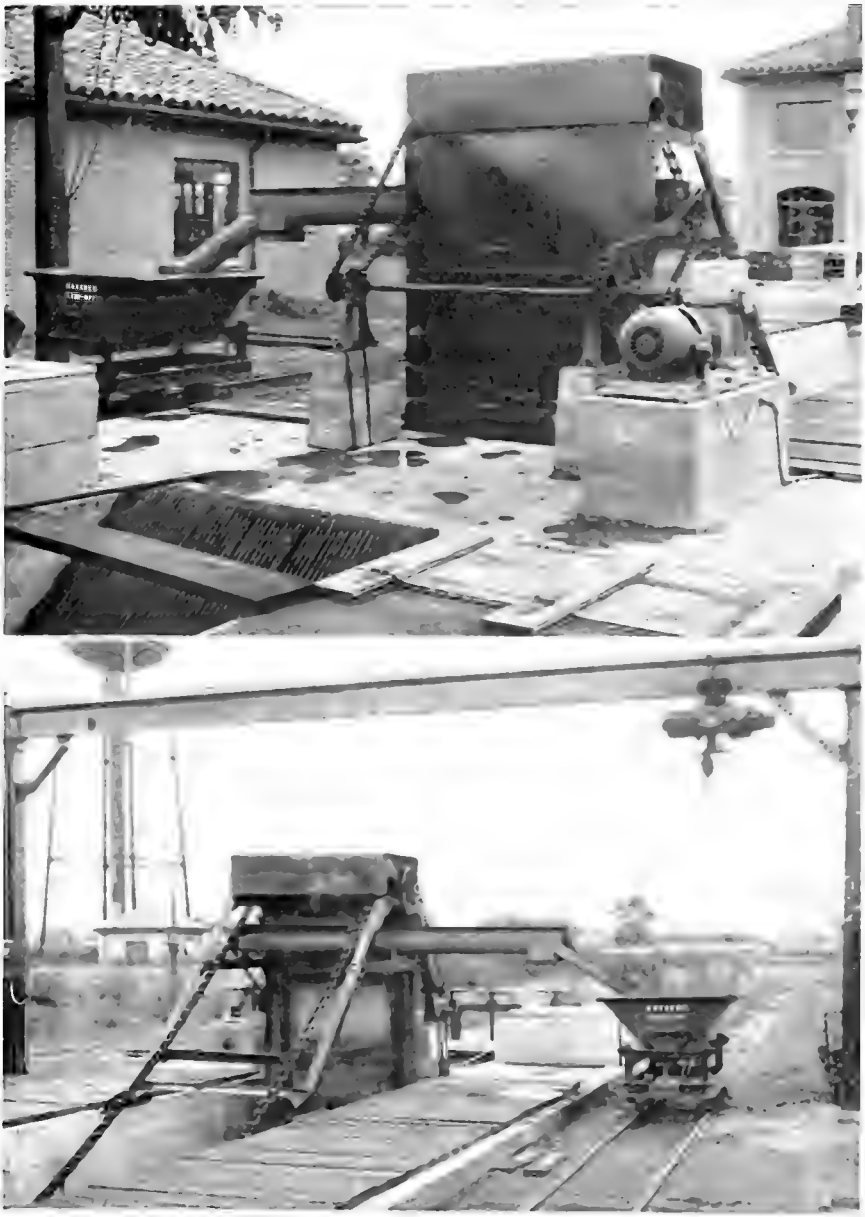
The building is 35 by 54 feet, inside dimensions. The wet well occupies a space at the side of the building outside, 12 feet in width the full length of the building, extending 16 feet below the ground level. The building proper, below the ground level, is occupied by what is termed the dry well, a sunken apartment in which are stationed the pumps, electric motors, switchboards and the starters. The floor of the dry well is 14 feet below the ground level.

The function of the machinery installed in the pump house is to lift the fluid emerging from the grit chamber as it accumulates in the wet well and force it up to the primary settling tanks through a large pipe. There are three pumps operated by electricity located in the dry well. These pumps go into action or shut down automatically as the liquid rises or falls in the wet well. There are three pumps which have a combined capacity of 14,000,000 gallons per day. One of 6,000,000 gallons and two of 4,000,000 each. The pumps work in any combination so that they have a capacity of 4, 8, 10, or 14 million gallons per day. This will take care of the requirements of the pumping plant for a population of 55,000 which will not be reached for several years under normal growth.

Besides the wet and dry well in connection with the pump house it contains on the first floor a central lobby and toilet and at the rear is a very completely equipped machine shop. On the second floor are two office rooms, transformer room, a room for meetings of the trustees, a large roomy fireproof vault for the keeping of records, and the chemical laboratory. The building is heated by steam.

The pump house is substantially built with reinforced concrete, waterproofed. The exterior is of tan brick, stone trimmed, tile roof. The floors and walls below ground are terrazo, and glaze brick above ground.

The pump house is virtually the business office of the sanitary district. Here are kept the daily records of rainfall, hourly records



GRIT COLLECTOR AND WASHER

This labor saving device was made for us by the Webster Manufacturing Company of Chicago, in 1931.

Before installing this machine the Grit Chambers had to be cleaned by hand, at a cost of seventy-five cents per yard, and the Grit had so much organic matter in it it was useless.

The machine has a capacity of two and one half yards per hour, making the cost of handling less than one cent per yard. The organic matter is washed out so the grit can be used on the sludge drying beds and on the roads around the plant.

This machine has handled an average of seven hundred yards of grit a year.

Inside of Grit Chambers

Sewer placement in deep cut

of temperature, the daily pumpage of sewage and daily analyses are made and recorded, checking the various operations of the plant to assure efficient operation.

PRIMARY SETTLING TANKS

All things considered, probably the most important unit in the sewage treatment plant is the primary settling tanks. The sewage after having been screened in the grit chamber is raised by the battery of pumps to the primary settling tanks where its slow passage through the settling tanks leaves an effluent now cleared of all coarser materials and most of the solids. The effluent from here being a dark liquid containing only about 50 to 60 parts per million of minute solids held in suspensions.

The settling tank is known as the Imhoff type. It is a sort of two story affair, both above and below the ground level. The first or upper story consists of six parallel channels into which the sewage is pumped at the upper level. These channels are 90 feet in length, 28 feet in width and 12 feet deep to the level where they begin to slope in a V shape to the lower story or level. Valves are so arranged that the flow of the fluid through these channels is very slow, one and a half feet per second. This slow movement of the fluid allows the solids held in solution to sink to the bottom of the channel into the lower compartment; at intervals this semi-solid matter known as sludge, is drawn off by opening the proper valves to allow it to run off and be discharged by gravity through a sloping channel or runway to the sludge drying beds just to the west of the primary settling tanks.

The lower compartment of each settling channel is known as a digestion chamber. Here certain bacterial action within the sludge as oxydized by the air, changes the chemical nature of the material without the addition of any foreign chemicals. In the digestion process there is a constant generation of menthane gas and certain carbon dioxides. These escape into the gas vent channel, one of which runs between and parallel with each settling channel.

Aerial view of Administration Building and part of plant site

Entrance to the Administration Building

At intervals during the day attendants remove from the top of the flow in the settling channels certain floating solids which fail to sink to the bottom; these solids are placed in the gas vent channel for further digestion to cause them to sink to the accumulated sludge at the bottom of the tanks.

The influent and effluent channels are so arranged that sewage may be admitted at either end of the channels and discharged at the opposite end: thus the flow at any time may be reversed permitting a more equal distribution of the sludge in the compartments below.

When the sewage has passed through the primary settling basins, approximately 80 percent of all solids has been removed. These solids thus removed and deposited at the bottom, here undergo the digestion process as described, and at proper intervals the resulting sludge is drained off by valve control to the sludge drying beds, either under the glass covered building or to the outside beds, in accordance with weather conditions.

Thoroughly digested sludge dries out in a remarkably short time making an earth colored humus, without odor or offensive smell. Six to 10 days is ample time for this drying process in ordinary weather. In wet seasons, or during severe winter weather the drying may be done under the glass roof, constructed like a greenhouse. The dried sludge, in the beds is about 3 or 4 inches thick. The sludge cakes in drying, cracks, and forms odd shaped lumps, making it easy to handle, and upon exposure to the air crumble into a coarse meal and may be handled just as is commercial fertilizer, and is no more offensive than finely pulverized soil. It is in demand for certain characters of soil rebuilding and fertilization. Experiments are being carried on here and at other plants looking towards preserving more of the fertilizing elements and increasing the value of the sludge as commercial fertilizer.

There are 20 sludge drying beds, each 22 by 95 feet in area, 10 on each side of sludge discharge channel. The beds have filtering material over them 13 inches deep over which the sludge is spread as it comes from the digestion tanks in the primary settling tanks. This filter is composed of sand, fine gravel and cinders that have been removed from the grit chambers as formerly mentioned.

The liquid which passes through this filtering process in draining from the sludge beds passes through a tile joining the effluent of the sprinkling filters, thus passing through the secondary tank for final settling of all solids carried in solution before being discharged as effluent into Sugar Creek.

THE DOSING TANKS

The impression conveyed by the words dosing tanks to the ordinary layman would indicate that some kind of chemical or other substance is added to the liquid drained from the primary settling tanks into the large basins in this building. This is an erroneous impression. The dosing tanks are simply great vats holding 35,000 gallons of liquid each, provided with automatic mechanical controls, so that when any one of the four tanks is filled, as they are in rotation, to the required depth, a trap springs and lets the fluid run out with a "head" of seven feet, which is sufficient to operate the sprays over the filter beds. If the natural flow of the primary settling tanks flowed direct to the filter beds, the force would not be sufficient to operate the spray. The four tanks housed in this building are identical in size and shape. Each tank is 24 feet square at the top, which size is carried down 4 feet 8 inches. From this point one side of the dosing tank slopes inwardly and the size at the bottom is 11 feet 9 inches by 24 feet.

These four dosing tanks hold 35,000 gallons each.

It takes just 4½ minutes for one of these large dosing tanks to empty its 35,000 gallons of fluid through the sprays over the filter bed to which it is assigned. All the liquid that enters these tanks passes through a very fine wire mesh screen for the purpose of catching any trash that might still be carried by the liquid, or that might accidentally have gotten into the liquid enroute, even debris the size of a match would clog the sprinkling nozzle through which it attempted to pass.

SPRINKLING FILTERS

The next important step in further clarification is performed by the sprinkling filters. This unit of the treatment plant is its most

spectacular one from the visitor's standpoint. He sees at intervals approximately 4 to 5 minutes over a large area of dark colored crushed stone, a great number of sprays, apparently shooting from the surface of the filter beds. These sprays discharge their now clarified water into the air, and it falls upon the beds in circles around each nozzle. After the discharge period of 4½ minutes the sprays on one side of the area cease, while the nozzles on the other side of the beds promptly start into action. This alternating system automatically continues at intervals throughout the 24 hours, summer and winter.

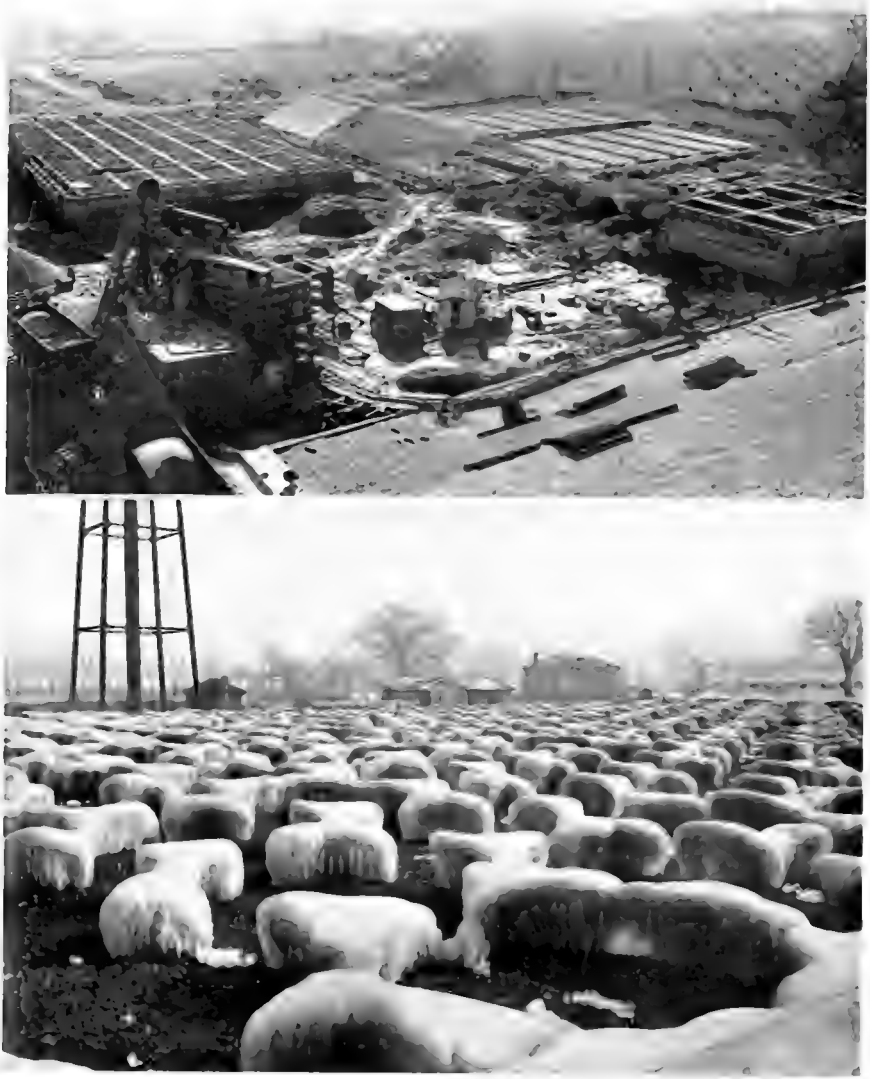
Each of the filter beds is 276 feet long and 197 feet in width, comprising an area of one and a fourth acres or two and a half acres for the total filter bed surface. The filter beds are composed of crushed stone 8 feet deep. Between the two filter beds runs a central operating and inspection gallery from which an attendant can keep accurate watch on the operation of the filters, and showing the character of the flow from the different sections of the filter beds.

The nozzles from which the spray is discharged are 14 feet apart, and there are 286 in all. Within the central control gallery are valves by which any of the sprays can be regulated.

The process performed by the filter beds produces another chemical change in the composition of the sewage. Being sprayed in a fine stream into the air performs a certain measure of oxydation. The water then falls down over the crushed rock and seeps through the 8 feet of bed, followed by air with its further oxydizing agency. In the periods of rest between the operation of the sprays, these particles of rock hold any fine bits of matter and allow a bacterial action, creating minute forms of life, which live their cycle, die and slough off in the form of colloidal deposits, mean—a thick sticky substance which takes its name from resemblance to the photographic film as commonly known.

The periodical cleaning of these filter beds from their accumulated bacterial deposits performs the secondary process in the clarification and purification of the sewage.

Top—Sugar creek in flood, Franklin Ave. before dredging
Bottom—Laboratory



Top—Aerial view of construction—*Upper left*—Primary settling tanks—
Upper right—Sludge drying beds
Bottom—Filter Beds, winter scene, 1935

The filter beds though acting in a measure as mechanical strainers are rather convenient surfaces upon which organisms may live, and surfaces which are intermittently bathed with atmospheric oxygen.

As mentioned before the filter bed in this plant is composed of crushed stone eight feet deep. The bed is provided with a concrete base having channels for carrying off the purified effluent. The crushed stone used is approximately the size of an egg.

Contrary to common misconception, the spraying of the water over the beds is not for the purpose of absorbing oxygen but rather to give uniform distribution of liquid over the surface of the bed.

The small stones in the filter bed become a refuge for minute organisms which feed upon the colloidal and dissolved materials in the sewage which have been absorbed into the jelly-like film that coats the rocks. Successive generations of organisms feed upon their ancestors. Thus the material of the film is continually worked over until at last it contains no further food material for the organisms. At that point the old film sloughs off and the growth of a new film begins. In filter bed operation this sloughing off occurs constantly, but twice a year, once each spring and fall a new growth starts and the old growth all sloughs off. In order to remove from the effluent the material which is sloughing off the stones, the liquid from the filter beds passes to what is known as a secondary settling tank, in which the remaining solids are settled at the bottom and by a series of revolving blades are forced into a central channel and returned to the primary settling tank to be united with the solids that here are separated out and go to the sludge beds rather than into the plant effluent.

Through the combined action of the primary settling, Imhoff tanks, sprinkling filters and secondary settling tank the biochemical oxygen demand of the sewage is decreased 90 to 95 percent, while suspended solids are decreased in like amount. The effluent from a well operated treatment plant is to be looked upon as recovered water of such quality that it may be poured into a stream without injury to the animal life of the stream.

Well Pump House in winter and summer

Top—Administration Building
Bottom—Outlet channel

SECONDARY SETTLING TANK

The effluent from the filter beds runs by gravity into the secondary settling tank. This structure is of reinforced concrete 70 feet square. The depth below the water level is 6 feet at the sides, and at the bottom of the tank slopes towards the center, where the depth is 9 feet. The flow is very slow through this tank, the detention in this chamber being one hour.

Revolving on the sloping bottom of the tank is a set of small scrapers or plows which force the small amount of sludge, the final and last settlings to be removed, towards the central outlet. Here a small pump takes this small quantity of sludge delivering it back to the primary settling tank where it now settles and goes with the major quantity into the sludge drying beds.

FINAL DISCHARGE

The effluent which has been the rounds of the entire plant and passes lastly through the secondary settling tank, is now ready for discharge into Sugar Creek.

Sanitary engineers speak of the unhealthful qualities of sewage in the ratio of parts per million. In this way we can see what remarkable changes have taken place in the sewage from the time of its entry into the treatment plant until its final discharge.

When the raw sewage entered the plant, it contained on an average of 125 parts per million of decomposable digestible material. The offensive, unhealthful contents 75 parts per million of non-digestible solids.

When it was finally discharged into Sugar Creek it contained only 10 parts per million of oxygen consuming substance. Thus, the liquid has had removed through the treatment plant 90 percent or more of its decomposable or digestible substances.

THE DISTRICT'S INVESTMENT

The improvement of Sugar Creek was a major work in the early years of the sanitary district. Its benefits and wisdom have been

proven many times over. The channel was not only deepened and widened, but the dirt removed, placed along the banks, graded, sloped and seeded to grass, presenting a clean and neat appearance. Old wooden bridges were replaced with new substantial concrete bridges, most of them paid for by the district.

The channel excavation and grading cost $31,630. The bridges $22,529, making a total cost of the whole improvement, $86,141.

Construction of the interceptor sewer cost $79,636.15 which together with the extension of the old trunk line sewers, and rebuilding of the Wood street to bring all the sewage of the two cities into the plant in one large sewer, cost a total of $183,309.49. The above improvements were independent of the construction of the treatment plant but a necessary part of the whole system.

The total cost of the construction of the treatment plant, grit chambers, pumping station, primary settling tanks, sludge drying beds, dosing tanks, sprinkling filters, secondary tank, with other small miscellaneous items cost a total of $637,958.96. The cost of the land for the plant site was $25,350.00.

ANNUAL COSTS

The law under which the Board of Trustees operates the sanitary district permits a levy of one sixth of one percent tax of the property within the district for operation and construction purposes with the added proviso that this may be increased at any time providing the increase is approved by the legal voters on submission to them. This expressed in another form is 16 and two thirds cents per $100 of assessed valuation. As can be readily seen this proviso is a necessary safeguard when it comes to construction work so that when necessary permanent and adequate construction may be done, that in the end might mean a large saving to the district.

The Board of Trustees is required to publish an ordinance each year setting forth the sums required for all expenditures proposed for the coming year, which ends April 30 of each year.

To give the reader a comprehensive idea of the expenditures and amount of tax levy for the year 1936-37, the following is the amount

of proposed expenditures and tax levy as published in the ordinance. It will be noticed that over half the amount of the levy is taken up by the item of borrowed money and interest on bonds. As these bonds are retired this expenditure is materially reduced each year. Any unexpended amount collected may be used to reduce the levy for that particular item the following year.

TAX LEVY FOR 1936-37

Office expense fund	$ 1,500.00
Tools and equipment fund	2,500.00
Salary fund	1,500.00
Contingent fund	2,500.00
Plant operation fund	20,000.00
Construction fund	15,000.00
Engineering Department fund	1,000.00
Law Department fund	2,000.00
Total above funds	$ 46,000.00

SPECIAL FUNDS

Borrowed money fund for payment of bonds and interest on bonds	$ 60,405.00
Total levy for the fiscal year ending April 30, 1937	$106,405.00

The bonding power of the sanitary district fixed by statute is two and a half percent of the assessed valuation of the district. The bonds not to extend over a greater than twenty year period.

BUSINESS ORGANIZATION

The business of the district is handled by a board of three trustees who are appointed by the County Judge for a term of 3 years. Each trustee receives a yearly salary of $300.

The first Board of Trustees was composed by John W. Harber, Bloomington; Frederic DeLoss Barker, Normal; and John J. Condon,

Top—Fifty-one inch intercepting sewer in construction
Bottom—Pump room of sewage pumping station

Top—Community gardens on plant property
Bottom—Aeroplane view of treatment plant

Bloomington. On organizing, the Board elected Mr. Harber president, Mr. Barber, clerk, and Mr. Condon, vice-president and treasurer.

Mr. Barber served until shortly before his death, December 19, 1925, and upon his retirement in December 1924, William McKnight of Normal was appointed in his place. Mr. McKnight served as clerk for most of his term. The next change in the Board was in May 1932, when Glenn Huffington of Normal, was appointed to succeed Mr. McKnight. In August of the same year, John Waterson of Bloomington was appointed to the Board to succeed Mr. Condon, who had died on July 17th. Mr. Waterson was afterwards elected president, which position he held to the end of his term in May 1936.

Upon the death of Mr. Folsom, one of the original firm of engineers for the district, J. J. Woltman was named in his place, the firm then becoming Taylor and Woltman.

On the death of Mr. Harber, the first president, in 1932, Mark R. Ethell of Bloomington was appointed to the Board. He was elected clerk, at which time Mr. Waterson was elected president.

In May 1935, A. M. Augustine of Normal was appointed to the Board to succeed Mr. Huffington and was later elected vice president and treasurer. Later in 1935 Earl R. DePew of Bloomington was appointed to the board succeeding Mr. Ethell, who resigned. The last change recorded in the Board was the appointment of Frank Donovan, Bloomington, in May 1936 to succeed Mr. Waterson.

Richard F. Dunn was named attorney for the sanitary district at its inception. He carried on the legal work during its organization, and the details of arranging the two large bond issues, that of $700,000 for the construction of the treatment plant, and the later one in 1933 for $100,000 for helping to finance the projects in cooperation with the Public Works Administration.

In May 1936, William C. Radliff was appointed attorney for the district to succeed Mr. Dunn.

H. E. Wilson of Normal has been plant superintendent since the organization of the district. He is responsible for every detail of the operation of the plant. In times of floodwaters that threaten the plant he has remained on duty continuously until all danger is passed.

Professor Howard W. Adams, a member of the faculty of the Illinois State Normal University was the plant chemist from its beginning until May 1936; at which time it was found necessary to employ a chemist devoting his whole time to the plant. Upon the resignation of Professor Adams, R. Kingsley Corrington of Normal was appointed chemist and bacteriologist. Since Mr. Corrington was appointed reports are now compiled daily of the operation of the plant as desired by the State Sanitary Board, as well as for the guidance of the superintendent and the trustees.

STORY OF THE BOND ISSUE

On October 3, 1925 the Board passed an ordinance calling for a special election on October 27, on the proposition to issue $700,000 in bonds of the district for financing the construction of the treatment plant and other necessary work. The proposition for the bond issue carried at the polls by a large majority. The bonds were issued in denominations of $1,000.00 all dated May 1, 1926. To date $404,000.00 of these bonds have been paid together with interest amounting to $292,150.00, a total of $696,150.00 principal plus interest. Thirty-seven thousand dollars principal and the accrued interest is being paid on these bonds annually.

OPERATING COST COMPARISONS

Probably few residents of the district are aware of the fact that the net cost per million gallons of sewage treated at this plant is less than at any other plant in the state, according to the latest figures compiled by the State Department of Health.

The figures published are as follows:

ANNUAL OPERATION COSTS

PER MILLION GALLONS OF SEWAGE TREATED

Aurora	$12.16	Springfield	$16.86
Decatur	32.90	Urbana-Champaign	28.40
Elgin	19.48	**Bloomington and Normal**	**9.18**
Greater Peoria	19.91		

PER CAPITA COST

Aurora	$ .591	Springfield	$ .62
Decatur	1.32	Urbana-Champaign	.379
Elgin	.80	Bloomington and Normal	.478
Greater Peoria	.67		

The primary purpose of a sanitary sewage treatment plant is the purification to the highest degree possible of the effluent that is turned into the streams, and when the following figures are examined we will find the Bloomington and Normal plant stands on a par with the best plants in the state, so that it can be seen, the economy in operation is not caused by slighting the work in any manner. Most of the credit for this excellent record can be duly accredited to the efficient, careful supervision given by the superintendent, Mr. H. E. Wilson.

* * * * *

Professor Adams may be quoted as to the useful purpose of the sanitary district's treatment plant. "More and more, communities are recognizing their debt to the people at large, and are discharging their obligation by sewage treatment, a worthy application of the golden rule of conduct. With this responsibility unrecognized, and this obligation undischarged by communities generally, our streams are bound to become more and more like open sewers. But a community which will take its sewage and clean it and send the resulting water singing on its way to bless others, is in this one respect at least a shining example of the spirit of good will."

BEAUTIFICATION OF THE GROUNDS

In accord with modern ideas for the proper surroundings of a treatment plant of this nature, those in charge of the Bloomington and Normal Sanitary District plant have sought, from the time of its establishment, to create an atmosphere of attractiveness rather than one of barren or unsightly character, removing as far as possible any cause for the unjust stigma of sewage treatment that naturally arises

in the mind of the public generally; so that landscaping of the grounds was begun in the initial stages of the plant, back in 1926-27. A. M. Augustine, who was later to become one of the members of the Board of Trustees was called in for advice when the grounds were laid out. His long experience as a landscape gardener and practical plantsman, gave him the background on which to plan the planting of necessary trees, shrubbery and flowers to create the general plan which was in mind.

A few large elm trees on the grounds were the only natural adornment. Otherwise all the trees and shrubs which are now in the tract were planted under the supervision of Mr. Augustine and of Mr. Wilson the superintendent of the plant.

It is estimated that 15,000 shrubs and trees have been planted in the nine years, and most of them have now grown to large size and beauty.

The pump house is a central figure in the whole layout, both architecturally and from a landscape viewpoint, the trees and shrubs which have been planted around it have grown until it is now half concealed in its arboreal setting. North of the pump house are screens of lilac and hedges of Illinois roses, and many varieties of shrubs, arranged for their general artistic effect. Flower beds are made in proper spaces with perennials and annuals planted for summer flowering.

On the grounds is the commencement of a botanical collection of Asiatic flowering crabs, hybrid grafted lilacs and hardy magnolias, comprising at present some 150 varieties which will be gradually increased until they comprise a very complete collection.

The newest addition to the adornment of the grounds which is expected to be completed this year, is the planting of the embankment surrounding the primary settling tank with trailing junipers. Eventually these will grow into a solid mass of green for the purpose of covering the ground and concealing the outlines of the embankment.

Another new phase of the grounds beautification is the construction of a rock garden near the main entrance to the grounds. This has been under gradual construction during the summer of 1936. It is

JAMES C. RILEY

The Bloomington and Normal Sanitary District has enabled the two cities to dispose of their sewage and storm water in a manner that has been a great benefit to both municipalities.

It is a source of satisfaction to have had some part in its organization and growth. After it was determined by the citizens of Bloomington and Normal by vote, that the district should be organized, it was incumbent on me as County Judge to nominate trustees who were competent to proceed with the construction and operation of such a plant as would serve the best interests of the two cities. I selected for the first trustees John F. Harber and John Condon, both of Bloomington, and Professor Fred D. Barber.

The results show that we were particularly fortunate in having such men accept the assignment. With Richard F. Dunn, the attorney first selected, these men perfected the plans and they and their successors, afterwards appointed by Judges Radliff and Hall, have built and operated one of the finest Sewage Disposal Plants and accessories in the State of Illinois. Our two cities can well be proud of the district.

JAMES C. RILEY.

RICHARD F. DUNN

I have had the privilege of organizing the Bloomington and Normal Sanitary District, and acting as attorney for the district from the day of its formation until May 1, 1936.

My work included preparing, circulating and filing the original petition for the creation of the district, preparing all necessary court orders including those for the appointment of trustees, preparing all appropriation and tax levy ordinances, all ordinances and documents relating to bond issues, preparing all contracts relating to ditch work, sewer and plant construction, and negotiating for the purchase of all easements, rights of way and plant site as well as all matters relating to annexation, from organization to May 1, 1936.

My work also involved advising with the trustees and engineers for the district on matters of policy relative to the annual as well as the long range programs of the district.

I shall always feel thankful for the favorable occasion which permitted me to devote my efforts to the general good of this community. I am happy to have had part in this great constructive movement.

Bloomington and Normal citizens have a just right to feel proud of their sewage treatment plant and the results which it has accomplished and is accomplishing through the efficient management of the trustees and employees of the district.

RICHARD F. DUNN.

proposed to have a central pool in the garden containing fish. It will be fed by a rivulet arising in a waterfall. This small stream will be fed from the effluent of the plant, demonstrating the clarity and purity of the water after it has undergone all the processes of the treatment plant. The fact that fish will live in and thrive in this purified sewage water is the most striking evidence possible of the purity and thorough treatment in the removal of oxygen consuming contents.

Fortunately the superintendent is a good gardener and a lover of the beautiful in flowers and plants and this has made it possible to gradually accomplish all the work of beautification except the initial landscaping with the regular help necessary to operate the plant thus entailing practically no extra expense. Every one connected with the plant is proud of the fact that the Bloomington and Normal plant is generally conceded to be one of the most beautifully planted and kept plants in the middle west and has often been cited as an example to other plants.

LATEST SANITARY DISTRICT PROJECTS

Although the primary objectives of the sanitary district improvements, namely the consolidation of the sewage systems of the two cities and the construction of the modern treatment plant were virtually finished by 1928, other important work of benefit to all the residents of the district was undertaken at much later dates.

During the worst years of the economic depression the Board of the Sanitary District sought means for co-operating with other public and government agencies to provide useful work for the large number of unemployed, at the same time obtaining permanent improvements in the district which would be of permanent use to the community. All of the projects undertaken, on account of the increase in population, were becoming more and more urgent and demanding attention, so that the financial assistance given by the Federal Government agencies relieved the taxpayers of the portion contributed that would have been a necessary expense in a short time.

Through grants and loans from the Federal Government agencies the district trustees by using some of the funds of the district, have

obtained several notable enlargements of district facilities in the way of storm sewers and other improvements. This work was done mainly in 1934-35 in co-operation with the Federal Work Relief Program, the CWA, the Illinois Emergency Relief Commission and the Works Progress Administration. Following is a description of the projects:

West Branch Sewer started by the district July 15, 1933 and completed June 13, 1934. This West Branch sewer consisted of approximately 12,500 feet of sanitary sewer, varying in size from 8 to 15 inches at a cost to the district of approximately $1.00 per foot, the same amount being supplied by the Federal Government.

The Highland Park sewer begun December 15, 1935, completed in the summer of 1936, at a cost of $87,500 of which $59,000 of the cost was supplied by the Federal Government. This sewer consists of 6,600 feet of 21-inch and 6,600 feet of 18-inch sewer. This sewer will supply sanitation heretofore depending upon the use of septic tank.

Highland Park Creek improvement is being developed under the same plan. This improvement was made necessary to furnish a proper outlet for the 72-inch storm water sewer which has its outlet in Highland Park. While at this time July, 1936, the work has not been fully completed, the total amount of cost of widening, deepening and straightening this channel, about two and a half miles, is approximately $73,300.00 of which the Federal Government supplied $64,500.

Due to this elaborate work program, the district, by cooperating with the government's work relief program at a time when jobs were so badly needed, was able to secure financial assistance to the amount of $161,057.72 by expending $49,742.28 giving a total expenditure for labor, material and right of way of $210,800.00 as noted previously. On account of increase of population it was only a short time till these projects could not have been put off further.

WILLIAM C. RADLIFF

It has been a distinct privilege to have served as County Judge during the construction period of this District. In a small measure it has given opportunity for service to my fellow beings. This, after all, is the highest contribution that any of us can make towards a useful life. During my regime the major construction of plant property was initiated and concluded, consisting of the following units: the Intercepting Sewer, the Grit Chamber, Pump Station, Primary Settling Tanks, Sludge Drying Beds, Dosing Tanks, Sprinkling Filters, and Secondary Tank. This combination of units constitutes the equipment for the treatment and disposal of the community's waste.

Since this construction period many problems of disposal have been solved. The art of treatment and disposal of waste, with the aid of laboratory control and chemical and bacteriology procedure, is rapidly being established as a science. Numerical interpretations are resulting in better understanding of treatment processes.

Respectfully,

W. C. RADLIFF.

ARTHUR R. WILLIAMS

STATEMENT OF THE AUDITOR

Ever since the commencement of construction of the Bloomington and Normal Sanitary District treatment plant, I have been charged with the task of making a monthly audit and the preparation of a monthly balance sheet for each of the Sanitary District Trustees the first Tuesday of each month, together with the itemized, annual published balance sheet.

Being connected with an organization that is doing so much to safeguard the health of the two cities of Bloomington and Normal has been a real pleasure.

ARTHUR R. WILLIAMS,
Certified Accountant.

THE BIG STORM SEWER

The major project undertaken by the sanitary district other than the construction of the interceptor sewer and the treatment plant, was that of building a great pipe line through the southeastern part of the district in 1933-35 to take care of the flood waters in seasons of heavy rains. For many years flood conditions had been a menace to the business properties and homes of a large section of the district known generally as the "Big Four Valley" because the area paralleled in a general way the route of the Big Four railroad tracks through the city of Bloomington.

In that region whenever a heavy rain occurred, basements were flooded, streets turned to rivers, and much property damage and annoyance caused to residents.

In 1933 when the Federal Government was making available work relief funds for public projects, the trustees of the sanitary district, in co-operation with the Bloomington City Board of Education, which had outlined a building program, submitted to the Public Works Administration, plans for construction of a big sewer system to avoid the floods which previously had occurred in the region mentioned.

On referendum vote of the district, the proposed bond issue of $100,000 to furnish the district's part of the necessary funds for this improvement, was favorably voted by a large majority.

In due process the bonds were sold as of date of March 1, 1934 at 4 percent interest. The government grant was $37,200.00. It was first planned that the bonds were to be sold to the PWA, a government agency; but when delay of disposing of the bonds threatened to delay the work on the project, the bonds in the sum of $90,000.00 were disposed of to a private banking corporation in Chicago at a premium of $5,004.00. They were to be paid in yearly installments from 1936 to 1940 inclusive.

It was many months after the sale of the bonds before the contract for the construction was let, to the J. L. Simmons Co., of Bloomington. The contract was finally approved by the government agency and the work started. It was estimated the work would provide employment for 90,000 man hours. The signed contract for the job was

received here in June, 1934. The number of men employed varied at different stages of the work and in varying conditions of weather.

The whole project was completed and turned over to the district on September 10, 1935. The drainage system was in several different forms. There were 1,600 feet of open trench work; 3,225 feet of tunneling under a ridge which formed part of the topography in the route of the sewer; an extra extension of 308 feet, making a total linear measurement of 5,133 feet, or approximately one mile.

The employment ran up to as high as 60 men a day for a time, and lesser numbers at other times.

The total amount paid on contract was $122,704.14. The government grant for the project was $38,164. The total costs were about $140,000.00, the excess over the contract price being the costs of engineering, supervising and the like.

The sewer was constructed with a carrying capacity of 200 cubic feet of water per second.

The physical purpose was to change the natural flow of the water in a small valley from southeast of Bloomington, into the city and through the valley to the southwest, and make it flow instead through a tunnel in a ridge and discharge in a valley in Highland Park. In tunneling the ridge the pipe line was at times as much as 50 feet below the surface.

Another purpose, which could hardly be called secondary, in having this work done in 1933-35 was to furnish a maximum of employment and thereby relieve the local load of unemployment distress for the two cities. This was accomplished; for scores of men found work at fair wages in a period when private employment was at a low ebb.

Mr. J. J. Woltman, who has served as engineer for the district from the beginning, acted as general overseer of these more recent improvements, including the big storm sewer.

Respectfully submitted by the Board of Trustees,

FRANK DONOVAN, President,
A. M. AUGUSTINE, Vice President and Treasurer,
EARL R. DEPEW, Clerk.

August, 1936.

Bloomington and Normal Sanitary District — Operating Report for August, 1936

DATE	DAILY PUMPAGE	K.W.H.	TEMPERATURE AIR SIX A M	AIR NOON	AIR SIX P M	AIR MAX	AIR MIN	SEWAGE SIX A M	SEWAGE NOON	SEWAGE SIX P M	PRIMARY TANK EFFLUENT SIX A M	PRIMARY TANK EFFLUENT NOON	PRIMARY TANK EFFLUENT SIX P M	RAINFALL	YARDS OF GRIT	YARDS OF RAGS
1	3930.000	610	62	85	86	90	52	67	70	70	70	70	72		1/2	1/8
2	3.890.000	600	66	86	86	89	56	69	70	70	70	70	70		1/2	1/8
3	4.050.000	620	70	83	85	88	64	67	72	72	70	72	72		1/2	1/8
4	3.930.000	620	70	77	76	77	65	68	72	70	70	72	72		3/4	1/10
5	4.980.000	760	61	66	68	68	61	68	71	70	70	72	72	.29	2	1/2
6	3.960.000	630	55	80	80	84	55	67	72	70	70	70	72		1	1/2
7	3.930.000	600	60	83	83	86	60	67	72	70	70	70	71		1 1/2	1/2
8	3.840.000	580	56	84	86	88	55	67	72	70	70	71	72		3/4	1/4
9	3.870 000	490	71	91	94	96	69	68	72	68	70	71	70	1.11	1/2	1/4
10	3.950 000	540	69	84	81	89	67	68	72	71	70	72	72	.64	2 1/4	1/2
11	5.100.000	780	63	87	85	90	62	67	72	72	70	72	72		2 1/2	
12	4.510.000	710	65	90	90	95	62	68	72	71	70	71	72		1 1/2	
13	4.260.000	660	75	96	92	100	72	68	72	72	70	71	72		1 1/2	1/4
14	4.480.000	650	72	78	89	92	71	70	72	71	70	71	73	.22	3	1/2
15	4.090.000	620	76	94	90	98	75	70	72	71	70	72	72	.14	3	1/4
16	4.430 000	600	72	89	93	99	72	72	72	72	72	72	72	.27	3	1/4
17	4.420.000	660	69	84	86	88	68	68	73	73	70	70	73		1	
18	4.270 000	760	73	94	97	102	71	68	73	73	72	73	73		1	
19	4140 000	600	78	93	91	96	78	72	74	74	70	74	75	1.51	1 1/2	1/4
20	5.290 000	720	71	89	89	92	69	70	72	74	72	73	75	.24	5	1/2
21	5 960.000	960	76	94	93	98	71	70	73	72	72	74	74		4	1/8
22	5.310.000	900	79	96	92	99	76	70	72	74	72	73	74		2 3/4	1/4
23	4.590.000	700	75	92	96	98	72	70	72	71	72	72	72		2	1/4
24	4.880.000	780	72	93	91	98	70	69	73	74	71	73	75		2 3/4	1/4
25	4.470.000	710	74	91	90	97	70	70	74	74	72	74	75	12	1 3/4	1/4
26	6 030.000	970	71	92	90	97	68	70	72	74	72	73	75		3	1/4
27	5 470.000	890	72	78	86	88	72	70	72	74	72	73	75		3 1/2	1/4
28	4.070.000	530	71	82	72	85	67	70	72	74	72	72	74	.98	1 1/2	1/8
29	5.550.000	750	59	73	71	75	58	70	72	71	72	72	72		2 3/4	1 3/4
30	4.820.000	730	55	75	70	78	54	68	69	69	70	70	70		1 1/4	1
31	4.890.000	550	51	81	78	84	49	68	73	69	69	70	73			
Total	141.550.000	19820												5.52	60	10
Average	4.570.000	639	68	85.8	85.6	90.4	65.5	68.8	71.9	71.6	70.7	71.8	72.6			
Max.	6.030.000	970	79	96	97	102	78	72	74	74	72	74	75			
Min.	3.840.000	490	51	66	68	68	49	67	69	68	69	70	70			

Average Last Mo.	4.176.000	20070	POWER COSTS		1.19	23	
Year Ago	3.070.000	14400	K. W. H.-P. M. G. P. 132		2.64	35	
5 Year	3.852 000	16064	COST—P. K. W. H. 1.6		3.61	50	
			COST—P. M. G. 2.11				
			317.12	Total for Year	2.09	473	

REMARKS: